User Manual

Lynx-GigE

Lynx-CL

ENG-2012-UMN018-R003

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000.03	18/03/2013	Chap. 10 Conversion Gain Factor to Feedback Capacitor added (input JBT)	CDU	
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000.06	19/07/2013	Small corrections	BVF	
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001.08	25/02/2014	Quantum Efficiency added	JDS	CDU
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002	03/03/2014	New issue of XLIN-TE0 Control & Operation in Appendix Second released issue	CDU	JDS
003	31/03/2014	Appendix mechanical drawing updated (EASM file removed) Third released issue.	CDU	JDS

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Change Details

This table lists all changes of this issue compared to the previous released one.

Chapter/Section	Changes	Modified by

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Table of Contents

Revision History 3
Change Details 4
List of Abbreviations 7
List of Figures 8
List of Tables 9
1. Introduction 10
1.1. Scope 10
1.2. Reference Documents 10
1.3. Manual Overview 10
1.4. Conventions Used in This Manual 11
1.5. Safety Warnings 11
1.6. Conformity 12
1.7. Contact Information 12
2. Mechanical & Electrical Specifications 13
2.1. Lynx Detector Specifications 13
2.2. Lynx-GigE and Lynx-CL Specifications 13
3. Getting Started 14
3.1. Connect to the Camera using Xeneth 14
3.2. Change Camera Properties 15
3.3. Use of Correction Files 16
4. Optical Interface 19
5. Electrical Interface 21
5.1. General Overview Connectors and Specifications 21
5.2. Power Interface 22
5.3. Trigger Interface 23
5.4. GigE Interface 24
5.5. Camera Link Interface 25
6. Software Installation 26
6.1. Xeneth Installation 26

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6.2. SDK Installation 26
7. Appendices 27
7.1. Appendix A 27
7.2. Appendix B 27
7.3. Appendix C 27
7.4. Appendix D 27
7.5. Appendix E 27

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List of Abbreviations

BPR	Bad Pixel Replacement
CC	Camera Control
CRC	Cyclic Redundancy Check
DHCP	Dynamic Host Configuration Protocol
FPN	Fixed Pattern Noise
GigE	Gigabit Ethernet
LSB	Least Significant Bit
MSB	Most Significant Bit
NIC	Network Interface Card
NTSC	National Television Standards Committee
PAL	Phase Alternating Line
PRNU	Photo-response Non-uniformity
RFU	Reserved for Future Use
SDK	Software Development Kit
TBD	To Be Defined
XSP	Xenics Serial Protocol

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List of Figures

Figure 3-1 Xeneth shortcut 14
Figure 3-2 Connection setup 15
Figure 3-3 Start Capturing 15
Figure 3-4 Access the camera properties 15
Figure 3-5 Correction pack upload: storage icon 17
Figure 3-6 Correction file upload 17
Figure 3-7 Xenics logo while correction file upload 17
Figure 3-8 Reconnect to camera with onboard correction 17
Figure 3-9 Enable image correction 18
Figure 4-1 Optical components: lens – insert – front 19
Figure 5-1 Camera power connector 22
Figure 5-2 Cable connector 22
Figure 5-3 Trigger interface pin assignment 23
Figure 5-4 Pin out of Camera Link connector on the Lynx-CL camera 25

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List of Tables

Table 1-1 Camera overview – Lynx-GigE and Lynx-CL 10
Table 2-1 Detector specifications 13
Table 2-2 Specifications Lynx-GigE and Lynx-CL cameras 13
Table 4-1 Lens configuration 19
Table 5-1 Electrical interface specifications for Lynx-GigE and Lynx-CL cameras 21
Table 5-2 Camera power connector $12V_{DC}$ 22
Table 5-3 Cable connector $12V_{DC}$ 22
Table 5-4 Camera Link connector (base) pin assignment 25

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1. Introduction

1.1. Scope

This User Manual describes the technical specifications, dimensions, image processing, basic and advanced parameters and related subjects for the following cameras:

Camera	# pixels	Pixel pitch [µm]	Part number
Lynx-512-25um-GigE	512	25	XEN-000309
Lynx-1024-12.5um-GigE	1024	12.5	XEN-000310
Lynx-2048-12.5um-GigE	2048	12.5	XEN-000311
Lynx-512-25um-CL	512	25	XEN-000312
Lynx-1024-12.5um-CL	1024	12.5	XEN-000313
Lynx-2048-12.5um-CL	2048	12.5	XEN-000314

Table 1-1 Camera overview – Lynx-GigE and Lynx-CL

1.2. Reference Documents

(Ref 1)	Xenics Serial Protocol	ENG-2011-ICD003
(Ref 2)	Mechanical Drawings Lynx-512-1024-2048-GigE and CL	
(Ref 3)	XLIN-TE0 Control&Operation	ENG-2013-ICD009
(Ref 4)	Framerate Calculator	ENG-2013-ICD011
(Ref 5)	Network connection set-up for GigE	ENG-2013-ICD003
(Ref 6)	Xeneth Installation Manual (see Xeneth SW directory):	ENG-2013-UMN024

1.3. Manual Overview

This section provides a chapter overview:

- Chapter 1 (this chapter) gives an overview of the conventions used in this manual (styles and symbols), the safety warnings, conformity information about Xenics cameras and the contact information.
- Chapter 2 gives a mechanical (2D drawings) and electrical overview
- Chapter 3 describes how to get started with the camera.
- Chapter 4 describes the optical interfaces
- Chapter 5 describes the electrical interfaces
- Chapter 6 provides the installation of the Xeneth and SDK software
- Chapter 7 lists the appendices.

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1.4. Conventions Used in This Manual

To give this manual an easily understood layout and to emphasize important information, the following typographical styles and symbols are used:

The styles used in this manual are:

- **Bold**: used for programs, inputs (commands or parameters) or highlighting important things
- Courier New: used for code listings and output.
- *Italics*: used for modes and fields.

The symbols used in this manual:

Note: This symbol highlights important information.

Warning: This symbol highlights important instructions. These instructions must be followed to avoid malfunctions!

1.5. Safety Warnings

The following safety warnings must be followed:

Supply voltage polarity: Use the correct polarity of the 12 V supply voltage.

Warranty: The warranty becomes void in case of unauthorized tampering or any manipulations not approved by the manufacturer.

Electrostatic discharge: The camera contains sensitive electronic components which can be destroyed by means of electrostatic discharge. Use sufficient grounding to minimize the risk of damage.

Environmental conditions: Operate the camera in dry and dust free environment.
Regarding the signal quality of the camera it is an advantage to operate the camera under constant ambient air temperature (~20°C).
Beneath or above ambient temperature a sufficient heating or cooling may be necessary.

Warm-up Period: Depending on the prevailing environmental conditions, some time might pass after the camera start, until the image quality reaches its optimum.

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1.6. Conformity

Xenics declares under its sole responsibility that all standard cameras of the Lynx family to which this declaration relates to, are conform with the following standard(s) or other normative document(s):

- CE, following the provisions of 2004/108/EG directive
- RoHS (2002/95/EC).

CE:
We declare, under our sole responsibility, that the previously described Lynx cameras conform to the CE directives.

1.7. Contact Information

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  Xenics is a European based provider of infrared imaging products and has representatives and distributor locations around the world to service our many customers.

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2. Mechanical & Electrical Specifications

The mechanical drawings of Lynx-GigE and Lynx-CL can be found in (Ref 2).

2.1. Lynx Detector Specifications

The detector specifications are summarized in Table 2-1:

Feature	Specification
Array Type	InGaAs
Spectral Band	0.7-1.7 µm
Quantum Efficiency	>80% (@ 1600nm)
# pixels	512 or 1024 or 2048
Pixel pitch	25 µm (512) or 12,5 µm (1024 and 2048)
Sensor gain	16 user selectable gain settings
Dark current at 25°C sensor temperature	For 512: $3x10^6$ [e/s] (typical value) For 1024 and 2048: $1.5x10^6$ [e/s] (typical value)
Frame rate (full frame)	40 kHz (for 512 and 1024) or 10 kHz (for 2048)
Window of interest	No
A/D conversion resolution	14 bit
Exposure time range	1 µs – 70 min Timer or trigger dependent exposure time
On board processing features	Digital fixed gain and digital fixed offset.

Table 2-1 Detector specifications

2.2. Lynx-GigE and Lynx-CL Specifications

The camera specifications are listed in Table 2-2.

Feature	GigE	CL
Frame rate (full frame)	40 kHz (for 512 and 1024), 10kHz (for 2048)	
Cooling	No	
A/D conversion resolution	14 bit	
On-board image processing features	Digital fixed gain and digital fixed offset	
Electrical interface	GigE Vision (image acquisition and camera control)	Camera Link (image acquisition and camera control)
Power over Ethernet	Yes	No
Trigger	Line and frame trigger	
Input Voltage	12V±10%	
Power consumption	< 4.6W	< 2.6W
Dimensions	49x49x71.2 mm^3	49x49x53.5 mm^3
Weight	208g	153g
Ambient Operating Temperature	-40°C to 70°C	
Storage Temperature	-50°C to 85°C	

Table 2-2 Specifications Lynx-GigE and Lynx-CL cameras

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i The design and specifications for the products described above may change without notice.

3. Getting Started

In this section we describe the different steps how to get started easily with the Lynx camera.

3.1. Connect to the Camera using Xeneth

The way to connect the camera to use Xeneth is the following:

- Connect all necessary cables to the camera. For details about the electrical interface and cables: see chap. 5.
- Install Xeneth on the pc. For the Lynx CL, make sure that the framegrabber is installed properly. For more information see chap. 6 & (Ref 6).
- Start Xeneth by clicking the Xeneth shortcut on the desktop to start up Xeneth (see Figure 3-1). The connection dialog will become visible (see Figure 3-2). When the camera is not shown, click the refresh button on the dialog. Select the camera, together with the calibration data suited for it. For more details, consult the Xeneth User Manual, section Connection setup - Settings.

Figure 3-1 Xeneth shortcut

- Select the camera in the Connection Setup window (see Figure 3-2).
- Select the calibration pack to be loaded (see Figure 3-2).
    - To use a calibration pack in software, select the name of the calibration pack (note that calibrations in software can **ONLY** be used for the Lynx-CL).
    - To use the onboard calibration use: <Camera memory>.
    - Press <Connect> to connect to the camera.
- Press <Start Capturing> to start grabbing frames (see Figure 3-3).

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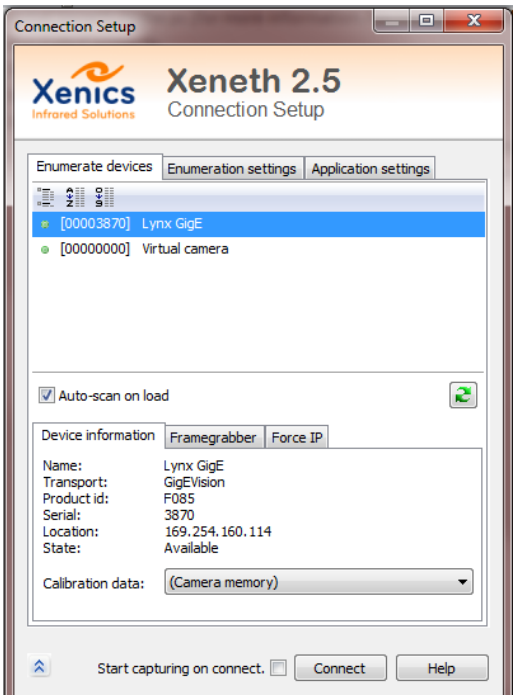

Figure 3-2 Connection setup

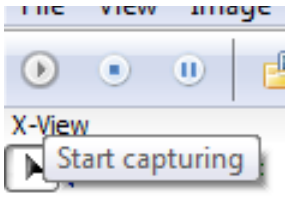

Figure 3-3 Start Capturing

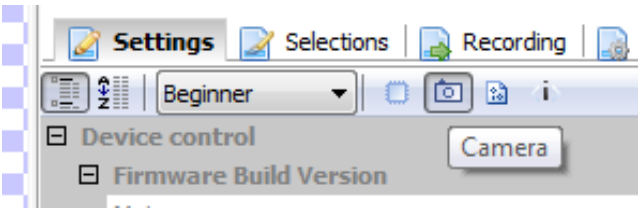

Figure 3-4 Access the camera properties

3.2. Change Camera Properties

Perform the following steps to change the camera properties:

- To change the camera properties, press the <Camera> icon (see Figure 3-4).
- When using the camera for the first time, use the Beginner mode (see Figure 3-4).
- In the beginner mode, the following properties can be modified by the user. For more information on the camera properties, see (Ref 3), or click on the property (Right-button-click) and select <Show property documentation>.

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- Device control:
  - Device gain: Value 0 to 15, to set the feedback capacitor value of the CTIA readout. For the values of the capacitor, see (Ref 3).
- Acquisition control
  - Exposure time: Sensor exposure time. Note that a correction file is only valid for 1 exposure time. When the exposure time changes, the offset should be re-calibrated.
- Image format control
  - Height: This value sets the number of lines within a frame.
- Image processing control
  - Offset: This poperty applies a global offset to the image.
  - Gain: This property applies a digital gain to the image
- GigE Vision Transport Layer (only for GigE)
  - Packet Delay

3.3. Use of Correction Files

Perform the following to use the correction files:

- To select a different correction in **software (only for Lynx-CL):** press the <Select> button and select a different correction file.

- To upload and use a **correction file onboard**, perform the following steps:
  - In Xeneth: go to the Settings tab / Storage icon (see Figure 3-5)
  - Upload the correction file:
    - Click on Correction file property and then on the green upload arrow on the right (see Figure 3-6).
    - Select the new correction file.
    - Wait till the file is transferred to the camera (= wait until Xenics logo disappears: see Figure 3-7).
  - Reconnect to the camera to activate the new correction file. While reconnecting, choose ‘camera memory’ calibration data (see Figure 3-8).
- The correction can be enabled and disabled using the **enable image correction button** (see Figure 3-9).

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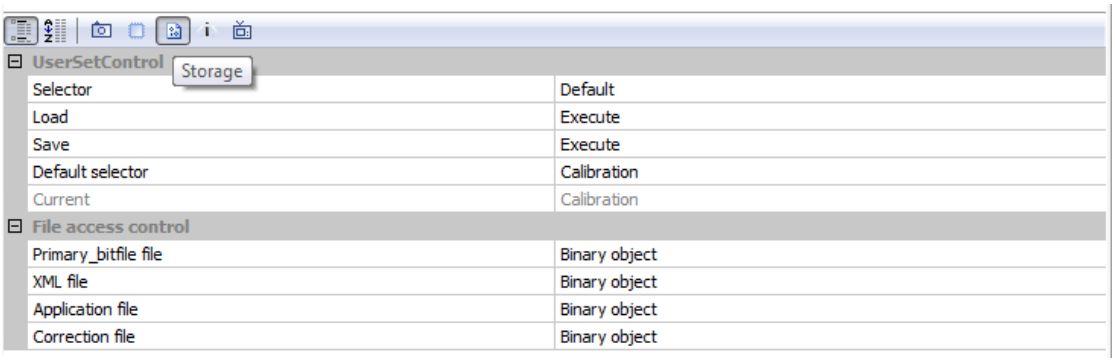

Figure 3-5 Correction pack upload: storage icon

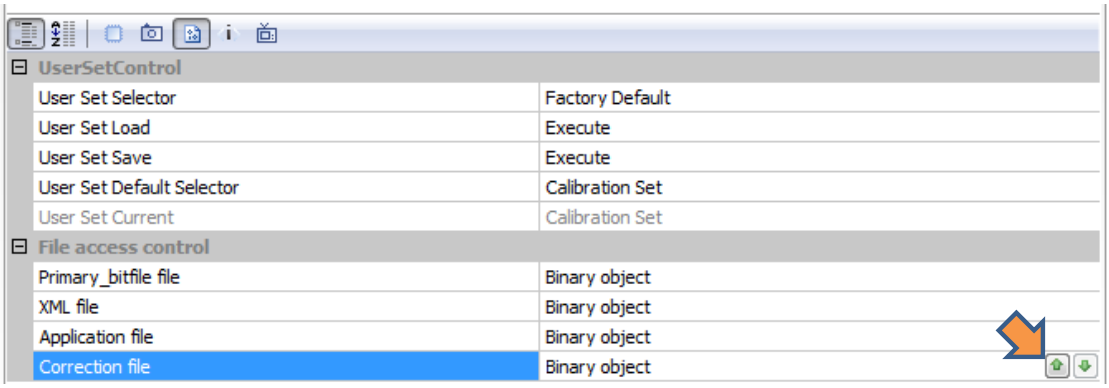

Figure 3-6 Correction file upload

Figure 3-7 Xenics logo while correction file upload

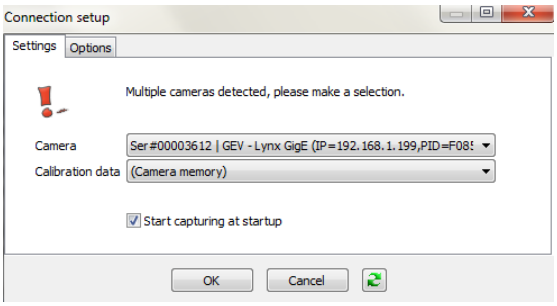

Figure 3-8 Reconnect to camera with onboard correction

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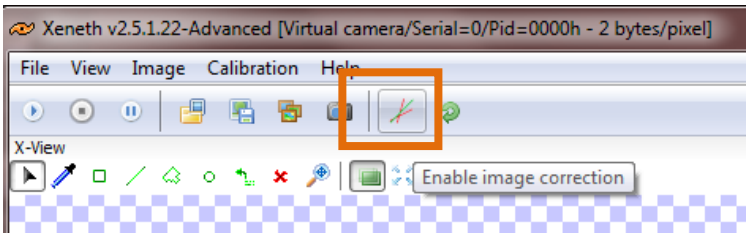

Figure 3-9 Enable image correction

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4. Optical Interface

The optical interface of the camera consists of three parts: the front panel, a lens insert and the lens itself.

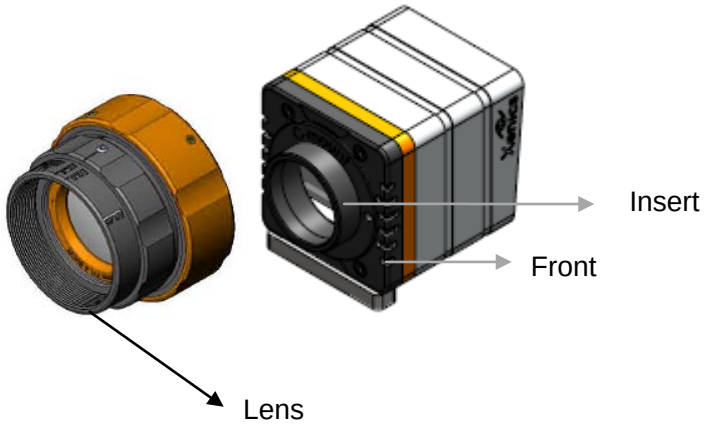

Figure 4-1 Optical components: lens – insert – front

A list of all possible lenses is shown in Table 4-1.

Lens configuration		Lynx GigE and CL
SWIR lens 12.5mm f/1.4	OPT-000106	x
SWIR lens 16mm f/1.4	OPT-000107	x
SWIR lens 25mm f/1.4	OPT-000108	x
SWIR lens 25mm f/2.1	OPT-000164	x
SWIR lens 35mm f/1.4	OPT-000109	x
SWIR lens 50mm f/1.4	OPT-000110	x
SWIR lens 50mm f/2.15 for 25.6mm	OPT-000184	x
SWIR lens 50mm f/2.0 + mount/filter holder	ASY-000657	x
SWIR lens 75mm f/2.0 + mount/filter holder	ASY-000443	x
SWIR lens 100mm f/2.0 + mount/filter holder	ASY-000444	x
SWIR lens 200mm f/2.4 + mount/filter holder	ASY-000658	x
C-mount extender rings	OPT-000119	x

Table 4-1 Lens configuration

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It is possible to use the following different solvents to clean a lens:

- Ethanol: removal of fingerprints and other contaminants
- Alcohol: final cleaning before use.

Perform the following steps to clean a lens:

1. Immerse lens tissue in Alcohol / Propanol or Ethanol (reagent grade).
2. Wipe the lens in "S" motion in such way that each lens area will not be wiped more than once!
3. Repeat stage 2 until the lens is clean. Use a new lens tissue each time!

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5. Electrical Interface

5.1. General Overview Connectors and Specifications

Connect all cables to the connectors at the rear side (see also (Ref 2)). Table 5-1lists the connector and interface specifications overview for the Lynx-GigE and Lynx-CL.

Interface	Connector	Specification	Camera Protocol
XSL-GigE			
Input power (12V DC)	Hirose HR10-7R-4SA(73)	12V ±10%	
Trigger (either Trigger-in or Trigger-out!)	SMA	Trigger in: $V_{IN,L}$ = 0.8V Max. $V_{IN,H}$ = 2V Min. $V_{IN,MAX}$ = 30V Internal Pull-down: R = 10kΩ	
		Trigger out: V_{HIGH} = 3.3V ±10% V_{LOW} = 0V	
Ethernet	RJ45 connector	GigE standard	GigE Vision
XSL-CL			
Input power (12V DC)	Hirose HR10-7R-4SA(73)	12V ±10%	
Trigger (either Trigger-in or Trigger-out!)	SMA	Trigger in: $V_{IN,L}$ = 0.8V Max. $V_{IN,H}$ = 2V Min. $V_{IN,MAX}$ = 30V Internal Pull-down: R = 10kΩ	
		Trigger out: V_{HIGH} = 3.3V ±10% V_{LOW} = 0V	
Mini-camera link	CONN SDR 26POS VERT RECEPT	Serial control: 115200 baud, 8n1 Levels: RS-644	XSP Protocol: see (Ref 1)
		Image acquisition: CL	CL Base protocol/ 1 TAP for image acquisition

Table 5-1 Electrical interface specifications for Lynx-GigE and Lynx-CL cameras

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5.2. Power Interface

The power cable must be connected to the backside of the camera (see chap. (Ref 2) for its location). Table 5-2 lists the connector pins overview. Figure 5-1 shows schematically the pin location.

For the power cable (ASY-001268) the connector pins overview is shown in Table 5-3. Figure 5-2 shows schematically the pin location of the cable connector (Hirose HR10-7P-4P(73)).

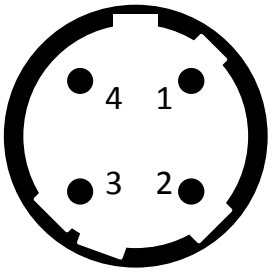

Figure 5-1 Camera power connector

Pin	Signal
1	+ 12V
2	+ 12V
3	Gnd
4	Gnd

Table 5-2 Camera power connector $12V_{DC}$

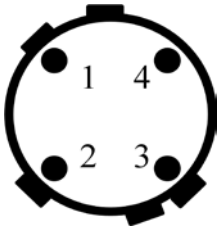

Figure 5-2 Cable connector

Pin	Signal
1	+ 12V
2	+ 12V
3	Gnd
4	Gnd

Table 5-3 Cable connector $12V_{DC}$

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5.3. Trigger Interface

Do not apply voltages to the trigger connector when it is configured in Trigger-OUT mode, because this will damage the camera!

For the trigger interface, a SMA connector is foreseen. The pin assignment is listed in Figure 5-3 Trigger interface pin assignment.

The trigger interface can be configured as **Trigger-IN** or **Trigger-OUT**. The following settings can be customized (see also (Ref 3)).

- Trigger OUT
  - Polarity:
    - High
    - Low.
  - Width
  - Delay.
- Trigger-IN
  - Source: frame or line trigger
  - Sensitivity
    - Level
    - Edge.
  - Polarity:
    - Low level / falling edge
    - High level / rising edge.
  - Delay
  - Trigger skip-count.

Pin	Signal	Cable
Shell	GND	Shield
Center	Trigger in	Inner conductor

Figure 5-3 Trigger interface pin assignment

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5.4. GigE Interface

GigE Vision® is a camera interface standard that uses the Gigabit Ethernet (GigE) communication protocol. It provides a framework for transmitting high-speed video and related control data over Ethernet networks.

To realize the GigE communication the Lynx-GigE cameras are equipped with a 1000Base-T Ethernet interface (RJ-45 connector). The data connection between camera and PC can be established via a standard CAT5e cable.

The GigE Vision standard defines how compliant products interact to deliver video and control information over Ethernet networks. It has the following four main elements:

- **Device discovery**: defines the sequence of events required for compliant devices to obtain valid Internet Protocol addresses, and for control applications to discover compliant devices.
- **GigE Vision control protocol (GVCP)**: defines how to specify video stream channels and control and configure compliant devices.
- **GigE Vision stream protocol (GVSP)**: defines how images are packetized and provides mechanisms for cameras or other types of video transmission systems to send image data and other information to compliant receivers.
- **An extensible mark-up language (XML) description file**: provides the equivalent of a computer-readable data sheet of features in compliant devices. This file must be based on standard defined by the European Machine Vision Association's GenICam™.

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5.5. Camera Link Interface

Camera Link is an interface for the transfer of digital video data. The standard defines data transfer on a physical base and determines connectors, cables and components for transmission and reception. Different configurations are available, distinguishing between the numbers of parallel transferred data bits.

For the Lynx-CL camera, the **BASE configuration with 1 TAP** is used. The pin lay-out and pin assignment of the Camera Link connector on the Lynx-CL camera are shown in Figure 5-4 and Table 5-4.

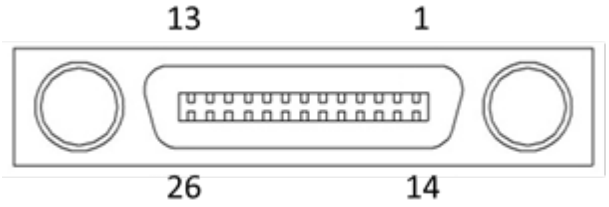

Figure 5-4 Pin out of Camera Link connector on the Lynx-CL camera

Pin	Signal	Pin	Signal
1	GND	14	GND
2	X0	15	X0+
3	X1	16	X1+
4	X2	17	X2+
5	XCLK	18	XCLK+
6	X3	19	X3+
7	SerTC+	20	SerTC-
8	SerTFG-	21	SerTFG+ P
9	CC1	22	CC1+
10	CC2+	23	CC2
11	CC3	24	CC3+
12	CC4+	25	CC4
13	GND	26	GND

Table 5-4 Camera Link connector (base) pin assignment

CC1 can be configured as line or frame trigger input (see also (Ref 3)).

CC2 to CC4 in Table 5-4 are not supported by the camera. The clock rate is 50 MHz with one tap & 16 bit/pixel.

i Info about the timing diagram can be found in (Ref 3).

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6. Software Installation

Before being able to start the camera, the Xeneth imaging suite (at least version 2.4) and its graphical user interface must be installed, so that the data coming from a wide variety of Xenics detectors and cameras can be easily operated on and analyzed.

6.1. Xeneth Installation

It is a good practice to first uninstall a previous Xeneth version when installing a new one.

Refer to the Xeneth Installation Manual (Ref 6) that is delivered on the CD together with the camera to install Xeneth.

When using camera link cameras, it is also necessary to pre-install the frame grabber before installing Xeneth! Refer to the National Instruments user manual of the frame grabber for installation instructions.

6.2. SDK Installation

When the SDK option was ordered, the SDK installation file is delivered on the CD together with the camera as well. Install the SDK software using this file.

After the SDK installation, the SDK manual, together with the samples and header files can be found in the C:\Program Files\Xeneth\SDK directory.

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7. Appendices

7.1. Appendix A

A detailed description of the Xenics Serial Protocol can be found in (Ref 1).

7.2. Appendix B

The complete mechanical drawing of the Lynx-GigE and Lynx-CL can be found in (Ref 2).

7.3. Appendix C

The Control and Operation of XLIN 512-1024-2048 TE0 cameras and cores document lists the registers which are described in (Ref 3).

7.4. Appendix D

The achievable frame rate and the minimal required frame time can be calculated using the Frame rate calculator sheet (Ref 4).

7.5. Appendix E

The network connection set-up and the camera functions and features for Lynx-GigE are described in more detail in (Ref 5).

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